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Priscilla  
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APPLIANCE FOR DISPENSING SCENTS AND AN  
AROMA STORE (SCENT CHIP)

[0001] The invention relates to an appliance for dispensing scents as recited in the preamble of claim 1, as well as an aroma store (scent chip) used in particular with said appliance for dispensing scents.

[0002] EP 0 611 476 B1 discloses a process for heightening the sensory perception of visual and/or acoustic presentations in motion picture theaters, theatrical venues, or in concert halls in which appropriate scents are directed at the audience synchronized with the presentation of certain visual and/or acoustic events or scenes. The scents are transported to the audience using air as the carrier gas. To accomplish this miniaturized individual pipes equipped with air outlets are routed to the seats in the venue, for example in the armrests or in the backrests of the seats in front of the audience member. The supplies of scents are provided in a releasable solid or liquid form, and they are dispensed by coming into contact with a flowing stream of air that is sent to the individual pipes from a source of compressed air. The total emerging air flow that transports the scent and reaches an individual in the audience should be less than 1 l/sec., preferably between 0.3 and 0.00001 l/sec.

[0003] A system such as this to deliver scents to accompany cinematic presentations, musical programs, or theater plays is difficult to implement in the market since it requires expensive installations in the performance halls and since the costs of such investments will not be acceptable until a sufficient number of productions are mounted on the market. Conversely, productions accompanied by the dispensing of scents will not be mounted until there are a sufficient number of halls equipped for this purpose.

[0004] EP 0 732 132 A2, a divisional application from EP 0 611 476 B1, discloses a corresponding scent-supporting system in which air is used as the carrier gas and in which permanent installations utilizing pipes are not used and the scents are supplied to the audience from a mobile unit synchronized with the presentation of various visual and/or

acoustic events or scenes. The mobile unit has a "scent composer" in which the required scent notes are mixed together from basic scent components in scent mixing rolls. A small tangential blower located inside the scent composer generates air that flows through the scent mixing rolls and picks up the specific scents of the basic scent components in order to compose the required scent. The scent composer is intended for use in relatively small rooms for decentralized applications, such as slide presentations or the presentation of video or television programs. The signal line for controlling the mixing rolls could be connected to a video tape player or a television, and control pulses for specific scenes could be sent to the television by means of a radio-frequency signal.

[0005] The object of the invention is to provide an appliance for dispensing scents that can dispense scents that are appropriate for specific events or scenes, and that can be used as an individual appliance without generating installation costs, and that operates with very small amounts of aroma or scent substances and meets acceptable standards of hygiene. The appliance that is to be created should generally be suitable for dispensing individual scents or a sequence of scents. The input for the scent or scents that are to be dispensed should be accomplished manually or through the transmission of a signal, for example over the Internet. The object of the invention is to provide an aroma store (scent chip) that can be mass-produced at an extremely reasonable price and can be used with an appliance for dispensing scents.

[0006] The invention accomplishes this object with an appliance for dispensing scents as characterized in claim 1. Further embodiments of the invention are described in the dependent claims. An aroma store (scent chip) in accordance with the invention is recited in claim 27 and the dependent claims relating thereto.

[0007] The appliance of the invention is characterized by the fact that a carrier gas like air is not used to dispense the scents. Rather, the scents are dispensed directly from an

aroma store, for example by means of a micrometering pump and atomization or volatilization. The scent or aroma cloud produced in this manner rises to the user's nose as a result of the natural convection produced by the user's body heat. Its intensity exceeds the threshold of perception and it thereby provides the desired olfactory stimulus.

[0008] The appliance is worn on the user's body suspended in front of the user's chest like a brooch, or worn like a chain around the user's neck, or it is inserted in the user's outer breast pocket like a ballpoint pen. The appliance can also be positioned in close vicinity to the user by other means, for example in an armrest (or on a hinged arm) of a chair. Only very minimal amounts of scents and fragrances need to be used due to the close proximity with the user's nose. A small blower can be used to assist the upward movement of the cloud of scent or aroma that results from natural convection, and a heater can also be provided. The heater also makes many scents richer and more complex.

[0009] After it has been perceived, the scent/aroma cloud is dispersed as a consequence of mixing with the ambient air. When this happens, the intensity of the scent/aroma cloud quickly falls below the limit of perceptibility. In addition, the phenomenon of olfactory adaptation brings the sensory stimulus to an end. As a result, olfactory experiences that are of precisely defined duration can be created.

[0010] A control unit, which is best equipped with a receiving module that allows it to be controlled from the outside by means of a signal- or pulse-generating unit, allows the desired scents to be dispensed in sync with the respective performance. No complicated installation or retrofitting work is required at the venue where the appliance will be used. All that needs to be installed at the venue is an additional signal unit or timing unit. The appliances themselves have their own independent power supply in the form of a battery or rechargeable battery. The scents and aromas are discharged directly into the ambient air from the stores, without having to pass through shared pipes and nozzles. This eliminates the need for additional cleaning

procedures. The system does not require any compressed air support, so no problems with objectionable noises are encountered. Miniaturization allows the appliance to be worn by the user in the form of a discrete and even attractive accessory, or it can be installed, clamped or clipped on in the immediate vicinity.

[0011] The appliance of the invention is intended both for private and professional use as a new dimension—not only with media applications. Examples of applications are: shopping, relaxation, meditation, video games, television, video, computer simulations, Internet, cinema, stage productions, and exhibits, to name but a few.

[0012] The cloud of scent/aroma, and also the amount of scent that needs to be stored can be kept to a minimum by discharging the scent in such a way that it is synchronized with the user's breathing. The breathing cycle takes about 6-8 seconds. Taking the scent release time and the average time it takes for the scent to flow to the nose into account, the scent is only discharged when it can reach the nose in one breathing cycle. This link to the respiratory process can also be used, for example, to determine when the user is beginning to fall asleep so a "wake-up" scent can be released.

[0013] The invention is described in greater detail below based on the attached drawings. The drawings show:

[0014] Figures ~~1a~~ and b are a schematic representation of the appliance of the invention in professional use, for example in a motion picture theater, or in private use, for example with television or the Internet;

[0015] Figure ~~2~~ is a schematic diagram of the design of an appliance of the invention;

[0016] Figure ~~3~~ shows the placement of the appliance of the invention in front of a user's chest;

[0017] Figure ~~4~~ is a schematic diagram showing the design of an aroma reservoir cartridge;

[0018] Figure ~~5~~ is a schematic diagram showing the design of an aroma store chip with enlarged representations of a storage space;

- a) in the at-rest condition,
- b) upon heating, and
- c) upon discharge of an aroma cloud;

[0019] Figure 6 is a schematic diagram of preferred embodiment of an aroma store (scent chip) using porous substances as the scent carriers

- a) with heating by means of an IR laser,
- b) with heating by means of a resistance heating element,
- c) and d) with isolation of the porous material from the carrier sheet by means of an aluminum shell or an aluminum vapor-deposited plastic shell
- e) embedding of the porous substance in a resin or plastic carrier
- f) embedding of the porous substance in a thermally conductive compound;

[0020] Figure 7 is an enlarged schematic diagram of a micrometering pump that utilizes piezoelectric actuators with a mechanical atomization nozzle;

[0021] Figure 8 is an enlarged schematic diagram of a micrometering pump that utilizes thermal actuators with a microheating element to volatize the discharged scent substances;

[0022] Figure 9 is an enlarged schematic diagram of a micrometering pump that utilizes piezoelectric actuators with an ultrasonic atomization unit;

[0023] Figure 10 is an enlarged schematic diagram of a micrometering pump that utilizes piezoelectric actuators with an electrostatic atomization unit;

[0024] Figure 11 is an enlarged schematic diagram of the discharge of gaseous aroma concentrate with a piezo valve controller;

[0025] Figure 12 is a schematic diagram of the release of scent synchronized with breathing.

[0026] Figures 1a and 1b show the appliance of the invention in professional use, for example, in a motion picture theater or in private use, for example with television or the Internet. The entire system comprises a

stationary transmitting unit and any number of appliances of the invention, each equipped with a receiving module. The transmitting unit is also the timer interface-i.e., the transmitting unit is combined with corresponding presentation devices or timer units. Signals such as time code or similar signals are used to control the scent/aroma sequences. The appliances of the invention can also be used in a stand-alone mode without external control.

[0027] The appliance itself is a mobile system used to create olfactory experiences. As shown in Figure 2, it essentially comprises four different modules: the control unit with receiving module, the power supply (energy storage unit), the aroma store, and the discharge unit for generating and discharging a scent or aroma cloud. The appliance can be miniaturized to roughly the size of a brooch or ballpoint pen, and it can be worn on the user's body as shown in Figure 3.

[0028] The aroma concentrate can be stored in the aroma store in gaseous, liquid, or solid (paste-like) form, or as a gel. The discharge and generation of a scent or aroma cloud is accomplished in various ways without the aid of a carrier gas, depending on how the aroma concentrate is stored—for example, by volatilization by means of microheating elements or laser energy, or by means of a micrometering pump, under valve control, as will be explained further based on the drawings that appear below.

[0029] The key elements of the appliance of the invention are the aroma store and the discharge unit for generating and discharging a scent and aroma cloud.

[0030] As shown in Figure 4, the aroma store can be an aroma reservoir cartridge that stores the required aroma concentrates 2 in many individual chambers 1. The individual chambers 1 can be filled with identical or different aroma concentrates depending on the application. In order to ensure that the aroma concentrate can flow back into the chamber during operation, a vent hole 3 is provided on the top of the individual chamber 1. In addition, within each individual chamber 1 the undesired escape of aroma is prevented by a

protective membrane or film 4. An electronically readable identification code can be provided on the individual chambers of the cartridge to provide information as to the type of scent, concentration, and how it was prepared. The aroma concentrate is released through an outlet hole 5.

[0031] An aroma reservoir cartridge is used in particular to hold aroma concentrates that are in liquid form. If the aromas are held in gaseous form, the individual chambers form pressure chambers, and the vent hole and protective membrane are not used. The outlet hole must be sealed by a rupturable hole or by a control valve.

[0032] An aroma store is preferably provided in the form of a microchip or as a chip card (scent chip) having scent substance storage spaces as shown, for example, in Figure 5. The aromas can be stored in the chip 6 or on a carrier in small microchambers or microtanks 7, or on small storage locations as a liquid, as a solid, as a gel, or also as a gas. Particularly in the case of liquid/gaseous storage or storage as a gel, the aromas or scent substances are protected under a protective layer or film 8. In the appliance, one element that can be controlled by the control unit is assigned to each scent substance storage location, for example in order to discharge the scent substance by thermal and/or electrochemical means. Heating a heating element 9 located under the chamber 7 or the storage location causes the aroma concentrate to vaporize, and the resulting pressure ruptures the protective film 8. The escape of aroma concentrate in the form of droplets can be prevented by a gas-permeable membrane (Gore-Tex<sup>®</sup>). The vaporization process causes the aroma to be discharged and form a scent or aroma cloud. In particular in the case of the rupturing protective film 8, the aroma storage locations 7 are used only once. In other words, after the storage location is actuated and the aroma is vaporized, the aroma concentrate that was present there is essentially used up. For scents that are used more often, a corresponding number of storage locations must be filled with the same aroma concentrate. In order to increase the intensity of a scent, a plurality of storage locations 7

can be activated simultaneously. The chip or chip card is generally replaced after the end of a presentation.

[0033] A reagent can also be assigned to the scent substance storage locations in order to initiate an exothermic reaction, for example, under defined conditions. In the appliance, one element that can be controlled by the control unit and that creates said defined conditions for the reagent can be assigned to each scent substance storage location.

[0034] Preferred embodiments of a scent chip are shown in Figure 6. These embodiments, which utilize a porous substance (such as zeolite) as the carrier for the liquid, gelatinous, or solid scent substance, release the scent substance by thermal means. On or in an inexpensive scent carrier sheet 20 (for example a resin/plastic film such as PTFE film or cardboard), the porous substance 21 is applied or inserted in small amounts in a checkerboard pattern.

[0035] In the case of Figure 6 a) the scent carrier sheet 20 is perforated, and the porous substance 21 seals the respective top of the perforation hole in the manner of a plug. The lower side of the perforated film 20 is sealed with a thin film 22. The hollow chambers 23 that are formed in this way serve as reservoirs for the various liquid scent substances, which diffuse into the porous substance. In order to prevent the undesired release of scents, the porous substances 21 can be sealed on their top side, for example using a wax. Beneath the scent carrier 20-23 high-power IR lasers 24 (VCSEL) are disposed in a corresponding checkerboard structure on highly thermally conductive  $Al_2O_3$  ceramic. The individual laser units are approximately 0.35 x 0.35 mm in size. The laser units can be controlled individually by means of a circuit produced using screen printing technology.

[0036] In the case of Figure 6 b), the individual porous substance portions 21 are saturated with the various scent substances or are covered with scent substances in the form of solid coatings. Resistors 25 that can be controlled separately from each other in the appliance are produced by

means of screen printing technology beneath the thin scent carrier sheet 20 on a ceramic or steel substrate board. These resistors, which are about 0.5 x 0.5 mm in size, are individually addressed in a checkerboard pattern by means of AgPb leads, and they are heated electrically.

[0037] In Figures 6 c) and d), the porous substances 21 are located in perforation holes in the carrier sheet 20 as shown in Figure 6a. To prevent the scent substances that have been drawn into the porous substance from diffusing into the carrier sheet 20, and to bundle the heating energy, the porous substance is embedded in an aluminum shell 20' (Figure 6c) or in an aluminum vapor-deposited plastic shell 20'' (Figure 6d). In Figure 6c, an electrical separating layer 20''', a layer of coating, for example, is provided facing the lower side of the carrier sheet 20 in order to insulate the electrically conductive aluminum shell 20' electrically from the heating elements 24, 25 disposed beneath it. If the aluminum or plastic shell is sufficiently stable, the carrier sheet 20 is not necessary.

[0038] In Figure 6 e) the porous substance portions are embedded in a resin/plastic carrier 20; and in Figure 6 f), they are embedded in a thermally conductive compound 20''' such as in a silicone adhesive containing  $\text{Al}_2\text{O}_3$  (bauxite).

[0039] The functional principle is as follows:

[0040] In Figure 6 a), the IR laser diode emits bundled light energy. This is absorbed by the porous substance in the scent carrier system and is converted to heat. This applied thermal energy heats the porous substance containing the scent substance, until the scent substance vaporizes and thereby releases the scent molecules.

[0041] By varying the laser's power and heating time one can dispense a specific quantity of scent substance and discharge scent substances more than once.

[0042] In Figure 6 b, the heating element is heated and then transfers energy in the form of heat into the contacting scent carrier system. This applied thermal energy heats the porous substance containing the scent substance until the scent substance volatilizes and thereby releases scent

molecules. Varying the duration of heating and the heating output allows one to dispense a specific quantity of scent substance and to discharge scent substances more than once.

[0043] The aroma store (scent chip), in particular that shown in Figure 6, can be manufactured very economically as a mass-produced item. It can be miniaturized to a size of about 30 x 40 mm and a thickness of approximately 1 mm, so that it is easily distributed, for example, in event programs. The user then merely needs to insert the appropriate chip into his appliance in order to release scents and, when the appropriate program (or advertising spot) is received, to enjoy the scent experience. For example, 100 to 400 porous substance portions (i.e. scent substance portions) can be disposed, for example, on the described scent chip. Each porous substance portion has an absorption capacity of 0.1-0.3  $\mu$ l scent substance for an olfactory sensation lasting about 10 seconds.

[0044] A discharge unit is needed to generate and to discharge the scent or aroma cloud when the scents are stored in liquid form in an aroma reservoir cartridge. A discharge unit of this type can be constructed with the aid of various technologies. The discharge unit essentially comprises two functional modules, namely a pump unit (not required for gaseous storage) and an atomization or vaporization unit. Microheating or piezo elements can be used to implement the pump units. The atomization unit can be made in a conventional manner using a mechanical nozzle, or it can be implemented with the aid of electrostatic or ultrasonic technology. The vaporization unit is implemented with the aid of a microheating unit. The discharge unit is prevented from running dry by the strong capillary forces in the nozzles.

[0045] When the appliance is turned off, the nozzles can be covered mechanically by a cap in order to prevent the slow release of aromas.

[0046] We shall now explain some discharge units used for liquid aroma concentrates based on Figures 7 to 11. For discharging liquid aroma concentrates, Figure 7 shows a micrometering pump based on piezo elements 10. The aroma

concentrate is pumped mechanically by this piezo element 10. When a voltage pulse is applied, the piezo element 10 moves upward suddenly and draws in liquid. Then the piezo elements returns to its original position, thereby pumping the aroma concentrates through a mechanical atomizer nozzle 11.

[0047] Figures 9 and 10 show corresponding micrometering pumps based on a piezo element 10. Instead of a mechanical atomization nozzle 11, Figure 9 shows an ultrasonic atomizer 12 or it indicates an electrostatic atomizer 13. The ultrasonic or electrostatic atomizer utilizes prior-art technologies, so that a more detailed description is not necessary.

[0048] Figure 8 shows the discharge of liquid aroma concentrates by means of a micrometering pump utilizing thermal actuators. When thermal actuators are used, the aroma concentrate is vaporized on microscopic "hot plates" (heating elements). In addition, the thermal actuators serve to pump aroma concentrate back into the system. When the aroma concentrate is selected, attention must be given to ensuring that no residue is left after vaporization.

[0049] At start-up, first heating element 15 near outlet nozzle 15 must be activated in order to vaporize the liquid that is present there and to eject it has an aroma cloud. After the vaporizer is empty, the liquid is pumped back in the feed line by activating heating element 16. After the heating element cools, new aroma concentrate is drawn in as a consequence of the capillary forces. In order to dispense the desired quantity of aroma, the cycle described above can be repeated as many times as desired, as is the case with the embodiment utilizing the piezo elements. The aroma concentrate can be heated by means of resistance heating, inductively, by using microwaves, etc.

[0050] A micrometering pump constructed using thermal actuators can utilize the prior-art principle of the inkjet printer. The bubble of vapor is generated by means of a heating element in the discharge nozzle at a given distance from the nozzle orifice. This bubble pumps a droplet of liquid, in this case the aroma concentrate, into the outside

atmosphere. Here too, the liquid drop may either be atomized or vaporized.

[0051] Figure 11 shows the discharge of gaseous aroma concentrate with a piezo valve controller. The aroma concentrate can be stored under pressure as a gas, or a gaseous aroma concentrate can be briefly generated using a heating element at the outlet of an aroma liquid store. In the resting position, a piezo element 17 closes the discharge opening 18 by means of an appurtenant sealing element 19. When a voltage pulse is applied, the piezo element 17 moves upward suddenly and opens the discharge opening 18, allowing the pressurized aroma concentrate to escape. The amount of aroma can be metered out by applying a plurality of pulses. The aroma cloud can be generated as described above by means of a mechanical atomization nozzle, or by utilizing ultrasonic or electrostatic methods, etc.

[0052] Figure 12 provides a schematic diagram showing how the scent/aroma cloud and thus the amount of scent being stored can be minimized by synchronizing the ejection of the scent with the user's respiratory process. An acceleration sensor 26 together with the filter 27 and evaluation unit 28 are assigned to the scent emitter 29. They analyze the user's current respiration frequency in order to calculate the next inhalation process in advance. Taking the scent release time and the average time that it takes the scent to flow to the nose into account, a wait-and-go signal is sent to the scent emitter 29. In this way, the scent is not released until it is able to reach the nose in a single inhalation operation. This results in the following advantages:

the amount of scent required to produce an olfactory sensation is decreased by a factor of 3

the risk that a person sitting next to the user will be exposed to the scent is reduced

the amount of energy consumed by the scent emitter is reduced

the respiration analysis can also be used to determine whether the scent has reached the wearer in order to adjust the dosage accordingly.